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An OK Science Teacher

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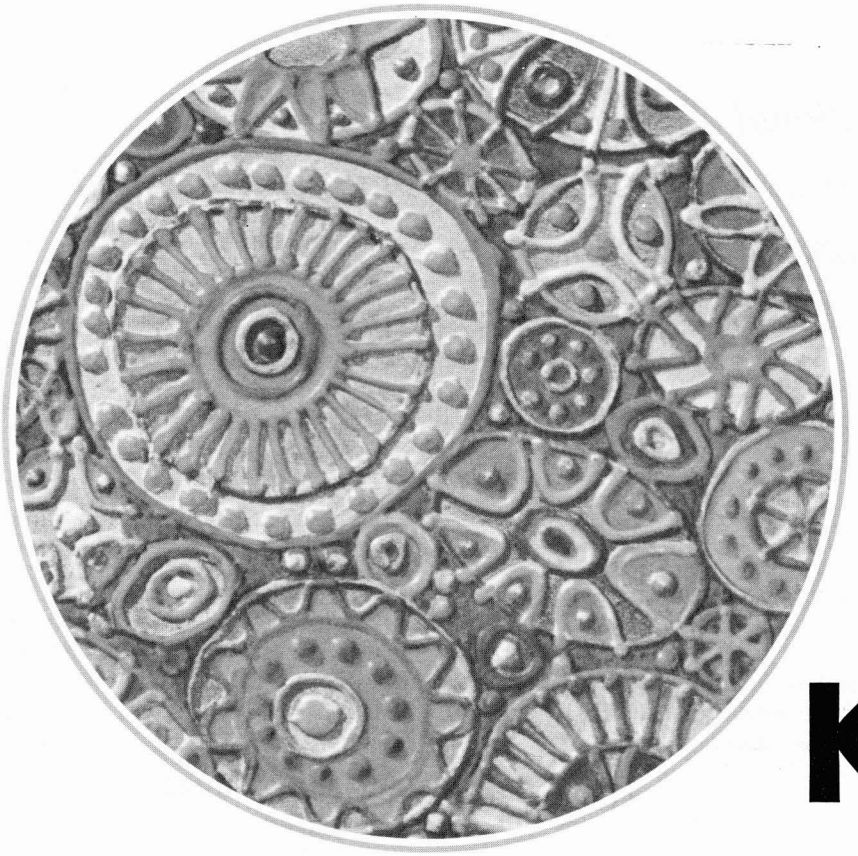

An K Science Teacher

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MANY elementary school teachers feel insecure and unsure in their teaching of science, i.e., they have NOT OK feelings about themselves and science. These feelings are based on the teachers' previous science experiences and on their interactions with other persons in science courses. The improvement of elementary school science programs depends upon the teacher's ability to deal effectively with his feelings about science. A complete science education program for an elementary teacher includes *three* components: (1) science content, (2) science methods that take into consideration the intellectual development of children, and (3) a practical psychology for developing positive human attitudes and interactions.

In attempting to cope with these three facets of science teacher education we developed a new course. It features the inquiry approach to learning science content. The science teaching techniques are related to the stages of intellectual development of children identified by Piaget. (1) The transactional analysis (TA) model as propounded by Eric Berne (2) is used to enable the prospective teacher to improve his self-understanding and his interactions with children.

Providing elementary school teachers with a background course of this kind has become necessary during the recent years of elementary school science curriculum revision. For example, projects such as Elementary Science Study, Science Curriculum Improvement Study, Science—A Process Approach (3), and Conceptually Oriented Program in Elementary Science (4), advocate inquiry through "hands on" experiences. Furthermore the importance of contemporary theories of learning and child development is apparent in the design of the experiences in these pro-

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grams. The prospective teachers in our combined course are provided with a selected list of readings (5) to update and/or reinforce their knowledge of the intellectual development of children and transactional analysis. (8, 12, 15)

Physics and the Elementary Teacher

"Physics—an Inquiry Approach" (6) was the title of a course offered during the two-week interim in January, 1972 and again in January, 1973. The course was designed primarily for elementary education majors and sought to combine content and method by introducing basic physics concepts using an inquiry approach.

The students spent most of their time working with materials and equipment. Since they did not have "I'm OK" attitudes toward science, they were encouraged to use the Parent-Adult-Child model of transactional analysis (7) to examine their behavior and assess their attitudes toward themselves when involved in science activities.

The students' reactions were quite positive. We have consequently developed a special course in physics and have also modified a science methods course for prospective elementary teachers. These courses are taught as a combined regular semester course. Students enroll for three semester credit hours of physics and three semester credit hours of elementary education. Our combined course is predicated on the notion that students learn from being both physically and mentally involved with real phenomena, materials, and objects, rather than from being told about or reading about science.

THE MAJOR EMPHASES OF THE COMBINED COURSE

Transactional Analysis

Transactional Analysis (TA) was first introduced as a general theory for understanding human behavior in 1957, and is familiar to many through the popular books *Games People Play* by Eric Berne and *I'm OK, You're OK* by Thomas Harris. (7) Transactional analysis has a scientific basis, a precise unit of observation, and a clear conceptual framework. Many of its terms are colloquial, e.g., the simple model of a person as composed of three parts (ego states): Parent, Adult, and Child. Hence TA is easy to understand and apply, but is very powerful in providing insights into the communicative intent of all human behavior. It offers the teacher a way of describing, classifying, analyzing, and improving the honest (straight) interchange of information for decision making, reality testing, probability estimating, and self-awareness. (8)

The TA model focuses on self-understanding and the creation of an OK self image as the vehicle for the improvement of interpersonal communication. To communicate with the OK other person, the OK (knowledgeable, confident, open) self can make a conscious decision and deliberate effort to create an atmosphere of inquiry, trust, and acceptance. The OK person succeeds by addressing his NOT OK feelings openly and developing his ability to turn off these feelings.

The Science Content

In "Physics—An Inquiry Approach" the students develop their ability to ask questions of nature, to obtain quantitative data relating to these questions, and to formulate appropriate hypotheses to answer their questions. These concepts are basic to those who wish to be scientifically literate and include measurement, mechanics, heat, light, and electricity. A more complete description of the physics course is available from the authors.

In addition to the physics concepts, there are selected topics from biology, the earth and space sciences, and chemistry that are appropriate for children. Many elementary science education textbooks, the latest commercial textbooks in science for children, and teacher materials for programs such as SAPA, ESS, SCIS, and COPES are available in a science resource center.

Science Methods

The methods aspect of our course is a mixture of content, methodology, human interactions, and learning theory. The teaching of science is intended to serve as an example of inquiry learning. The students are encouraged to discover

as much science as possible on their own. They are given instructions and operational definitions and asked to formulate general rules and hypotheses.

The Reflection Unit

For example, consider one unit, on reflection. The objective is to examine the properties of the reflection of light from a mirror. The students are given a plane mirror, some pins, a protractor, and a cardboard surface. They are given operational definitions for a ray of light, the angle of incidence and the angle of reflection, and they are shown how to use the apparatus to do simple ray tracing. They are asked to state a quantitative hypothesis about the relationship between the angle of incidence and the angle of reflection for a plane mirror and to describe a method of locating the image of an object viewed in a mirror.

When the students have completed this task they ask the instructor for another reflecting surface (a curved mirror) to use to test their hypothesis and image location method. If they successfully test their hypothesis, they are ready for another topic. If their hypothesis does not succeed they formulate another one and test it.

There is continuing interaction between students and instructors. During the first few class periods of the course the basic transactional analysis model is introduced to the students. They are expected to develop a working understanding of it through the use of reading assignments, discussions, and (homework) questionnaires. Their understanding of TA is then practicalized through a variety of small group activities such as role playing, story telling, and critiques. To assist them in understanding themselves and empathizing with their future pupils, we put our students into a number of stressful situations. For example, the first day of class a difficult science and mathematics pre-test is administered. This examines their basic skills and "hooks their NOT OK feelings." Several of the test questions are designed to expose these feelings, such as "Explain how a light switch turns on a light bulb and if you have difficulty explaining this, discuss why." At the end of the first day an evaluation form is given to the students and they are asked to write down their feelings about the pre-test. These feelings are discussed the following day.

Subsequent group experiences are planned to give them an opportunity to experience frustration with nature and its stubbornness. Conflict situations are also staged within the classroom: The instructors become involved in an argument about which learning activity should be presented next and the students help resolve the conflict. Later group discussion is used to assist the students in understanding their behavior within that conflict situation. Two of the students are secretly instructed to play a dominant "Parent" role during the experimental activities of their groups. They use

FIGURE 1. Transactional Record.

Place_____ Date_____ Observer_____

Brief description of setting:

Subject A	Subject B	Subject A	Subject C
P	P	P	P
A	A	A	A
C	C	C	C
What was the stimulus?		What was the stimulus?	
What was the response?		What was the response?	
Identify clues:		Identify clues:	
Your comments about these transactions:		Your comments about these transactions:	
Did you see this as effective communication?		Did you see this as effective communication?	
Explain		Explain	

strict "Do it this way" language to their peers.

After a short time the various groups are stopped and their feelings about the group interactions are discussed and analyzed to help them use the TA model to explain their interactions. Several TA tools for "hooking the Adult" and "affirming the OK" are used. (9) Subsequent class experiences are viewed within the framework of the student's increasing understanding of himself and the importance of his transactions in the teaching and learning of science.

Early in the semester the students begin observing children in elementary school classrooms. Their observations are focused on the transactions that occur between one child and other persons. Two college students are encouraged to select the same child to observe, but each makes a separate record of his observations on a transactional record (Figure 1). Later, in the methods class, the students discuss the transactions they observed. During the progress of the semester each student observes at least three different children in different grades, recording and analyzing their transactions.

As the semester progresses and the students develop a more "I'm OK" perspective, and as they observe children's transactions, their attention is directed to the levels of intellectual development of children. (10) They read articles which provide a description of the stages of the intellectual development of children from the research of Piaget, (11) and the Piaget developmental theory films on classification and conservation (12) are shown and discussed. Later the college students administer some Piaget-like tasks, such as those described by Bass and Montague (13) and Bybee and McCormack (14), to children of different chronological ages.

One of the most challenging assignments in this course for both students and instructors is the requirement that each student design a teaching plan for two science topics. It is challenging to all of us because we have limited experience in developing teaching plans that specify the kinds of transactions that might occur and that also specify the intellectual developmental level for which it is intended.

Each teaching plan includes the use of real materials and states one or two behavioral objectives. Using the models from transactional analysis the student writes "typical" transactions that might occur as elementary children participate in the activities he has designed. He is to consider transactions between teacher and pupil, give examples of Parent reactions, and suggest Adult responses.

Next, each student examines his teaching plan from the perspective of children of different intellectual levels of development. For example, how will he, as a teacher, respond if a child in third grade cannot "see" volume relationships? What additional experiences could be provided? The student includes in his teaching plan experiences deemed appropriate for different levels of intellectual development.

In conclusion, each of these prospective elementary school science teachers—supported by successful inquiry experiences in a college science course, informed by a practical working knowledge of the Piaget model of the intellectual development of children, and improved in his self-understanding by the use of transactional analysis—is better prepared to direct the learning activities of elementary school children in science. He is able to decide to become an OK science teacher.

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